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U.S. Monetary Policy Announcements and Foreign Exchange Market Behavior

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Abstract

This paper examines the time-varying and currency-dependency nature of exchange rate responses following the U.S monetary policy announcements. Using high frequency exchange rate data in the past decade, we find that the exchange rates of most major currencies against the US Dollar respond negatively to the monetary surprises in the 2001 recession, while the response becomes positive during the 2008 recession. Meanwhile, the JPY has the opposite response than the other major currencies in the 2008 recession. These results further confirm the nonlinearity in the relationship between exchange rate dynamics and fundamental news announcements.

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1. Introduction

There have been an increasing number of studies focusing on the reaction of foreign exchange markets to fundamental news announcements since the early 1980s. The natural motivation for studying this topic is a fundamental goal of financial economics: to understand the determination of prices – exchange rates – specifically in the foreign exchange market. These studies can inform us on how policies influence the market, what profitable trading strategy can be designed based on the news effect and what micro foundation on which fundamentals-based asset pricing models are built. The study of announcement effects is of great importance for all practitioners, academics and policy makers.

In the extensive literature, from earlier work of Cornell (1982 and 1983) and Engel and Frankel (1984) to recent ones such as Andersen et al. (2003), researchers have consistently found that the foreign exchange market has significant and speedy responses to fundamental announcements, in which U.S. money supply, interest rates, employment, output, the trade balance are among the most important.

As increasing exchange rate dynamics studies, such as Cheung and Chinn (2001), Rossi (2005) and Sarno and Valente (2009), suggest the relationship between the exchange rate and macro fundamentals is nonlinear and highly unstable; the impact of news surprises on exchange rates might also contain regime-switches which depend upon a number of factors including the state of the economy. Accordingly, studies such as Clarida and Waldman (2007) and Engel et al. (2007) argue that exchange rates exhibit state-contingent asymmetric responses to news. Fatum, Hutchison, and Wu (2010) further examine the topic for a wide

variety of announcements and find asymmetries in regards to Japanese business cycles while holding the U.S. business cycle constant.

The most recent development of exchange rate dynamics theory pushes the asymmetric and nonlinear news effect of exchange rate to a new level. Ding and Ma (2010) argue that exchange rate dynamics are subject to the state of economy, but the causal relationship, even within the same business cycle phase, is still time-varying and currency dependent. This implies that even within the recession phase, the same expansionary policy news can cause different effects in the FX market at different periods of recession. Meanwhile, different currencies might have different responses to the same news announcement within a certain time period.

In this paper, I provide an empirical examination of the pattern of exchange rate responses following U.S. monetary policy announcements. I will focus on monetary announcements only to minimize the difference between the effects of different types of the macro news. I use high frequency exchange rate data to examine the market reaction in the very short term to eliminate any overlap with the effect of other influential market news. To observe any time-variation of the news effect for a certain currency, my sample contains data from 2001 to 2010, including two major recessions. I also cover five major currencies to detect any inconsistency of the news effect across currencies.

My results show that exchange rates do exhibit time-varying and currency-dependent responses following U.S. monetary policy announcements. The responses vary across the state of economy and within the recession phase. Interestingly, my results show different reaction patterns in the 2001 recession and the 2007-09 recession. In the 2001 recession,

exchange rates respond negatively to the monetary surprises (i.e. the dollar depreciates following the Fed funds rate cut), with the CAD, CHF and EUR[1] giving the most significant responses. In the 2007-09 recession exchange rates respond positively to the monetary surprises (i.e. the dollar appreciates) except for the JPY, which shows significantly negative correlations with the news surprises.

The rest of the paper is organized as follows. Section 2 reviews the relevant literature. Section 3 presents the underlying theory. Section 4 describes the dataset and some preliminary analysis and section 5 provides empirical evidence. Section 6 checks the robustness of my models and section 7 concludes and suggests future improvements.

2. Literature Review

The Efficient Market Hypothesis predicts that prices should adjust very quickly to the surprise component of public news. Extensive literature has been conducted to test this hypothesis. Ederington and Lee (1995) use tick-by-tick data and find that exchange rates overreact in the first 40 seconds and then retreat over the next couple of minutes. Andersen et al. (2003 and 2007) confirm previous findings that a very rapid change shows up as a price jump and there is no systematic movement afterwards. Researchers have also investigated the effect of pre-scheduling on speed of price adjustment. Almeida, Goodhart, and Payne (1998) study the high frequency reaction of the DEM/USD exchange rate following macroeconomic announcements released from the U.S. and Germany. During the 1992-1994, markets are less responsive to news emanating from Germany, which is unscheduled. The authors conclude that uncertain release times lead to less significant and more gradual adjustment following the

[1] CAD– Canadian Dollar, CHF– Swiss Franc, and EUR– Euro

announcement because agents do not have time to form expectations and make adjustments in response to the surprise component of policy announcements.

This leads us to the second branch of literature, where a number of studies start to focus on market perceptions of policy and the economic rationale behind it. Uncovered interest rate parity implies that announcements that raise (lower) current domestic or expected future domestic interest rates relative to foreign interest rates tend to immediately appreciate (depreciate) the domestic currency. Therefore, announcement reactions tend to vary over time and between countries, and with the state of the business cycle, as the market perception of the current or future state of the economy changes (Neely and Dey, 2010).

Researchers have examined how markets react to similar announcements across countries (aka. the geographic origin of news). Doukas (1985), using daily data, compares the CAD /USD exchange rate reactions to the U.S. and Canadian money supply announcements from 1974 to 1978. He finds that U.S. monetary surprises are more influential on the exchange rate market as compared to their Canadian counterparts. One explanation is markets believe that the Bank of Canada makes their monetary policies following the Federal Reserve to maintain stable exchange rates (Neely and Dey, 2010). Thus, the Canadian monetary policy announcements are perceived to be less important than the U.S. monetary news. On the other hand, Fatum, Hutchison, and Wu (2010) find that, overall, Japanese macro news are as important as U.S. macro news in influencing the JPY/USD exchange rate.

Foreign exchange rate responses to macroeconomic shocks also depend on the sign of shocks and the state of the business cycle. Galati and Ho (2003) and Ehrmann and Fratzscher (2005) find that the "sign" (i.e. whether it is good or bad news) matters and that the

EUR/USD exchange rate responds more strongly to negative shocks. Andersen et al. (2003), using 5-minute exchange rate data, produce a comprehensive event study of the U.S. and Germany announcement effects and find that markets react asymmetrically to positive/negative announcement surprises. However, the authors only provide graphical evidence of asymmetric responses and do not perform formal tests. They extend the analysis conditional on the state of the business cycle in a more recent paper (Andersen et al. 2007) and find evidence that equity markets react negatively to positive real economic shocks in expansions whereas positively to similar shocks in contractions. No major conclusions are made for the foreign exchange markets.

Two recent papers push the analysis further by formally testing the state-contingent exchange rate responses to news. Pearce and Solakoglu (2007) employ high-frequency observations on the DEM/USD and the JPY/USD for a 10-year period. The sample covers one major recession in the early 1990s. They find apparently linear, symmetric and rapid effects of 11 types of U.S. shocks and argued that the effects depend on the state of the economy (i.e. recession versus expansion). Fatum, Hutchison, and Wu (2010) differentiate by studying exclusively the Yen-dollar return, which is interesting as Japan's money market interest rate was effectively zero under their period of study (1999-2006). Due to the limitation of sample size, they are only able to perform formal tests across the expansion and recession of the Japanese business cycle while holding constant the state of the U.S. business cycle. Again, they confirm that new effects do depend on whether they occur in recession or expansion of the business cycle.

In summary, the existing literature has found asymmetric exchange rate responses under

the following three conditions: different country origin of news, positive/negative announcements, and expansion or recession phase of the business cycle. We are curious whether the exchange rate response pattern would be consistent across time and currencies after we control for all these conditions. In other words, I am going to examine only one type of news released from one country of origin during the similar states of economy.

My paper builds upon previous research while examining aspects that have been overlooked. First, my sample period is more inclusive than the existing work in that it contains both the 2001 recession and the 2007-09 recession. This allows me to examine any variation in exchange rate responses within the recession status of economy for a particular currency. Second, I use high-frequency exchange rate data and am interested in the price jumps right after the news release. I examine one macroeconomic news variable – U.S. monetary policy – one of the most influential policy announcements for the financial markets. Hence one can attribute almost all of an exchange rate's movement to the announcement in a sufficiently small window around the announcement (Neely and Day, 2010). Third, I am interested in observing any variation in news effects across currencies holding the time variable constant.

3. Theory

Announcement reactions reflect market perceptions of policies and how such policies change over time. Any surprising change in policies that goes beyond market perceptions should cause significant market reaction. Fama's (1970) semi-strong form Efficient Market Hypothesis suggests that asset prices should always approximately reflect the marginal investor's current expectations and prices should quickly react only to the surprise component

of an announcement at the time of the release. Consistent with the existing literature on exchange rates and news, I focus on the surprise component of U.S. monetary policy only, expecting to see significant exchange rate reaction following changes in policy announcements.

In addition, the way that the news fundamentals are transmitted into exchange rates also depends on the market expectation of the current and the future state of economy. Uncovered interest rate parity suggests that a surprise decline in U.S. interest rates should cause the dollar to depreciate. Moreover, an expected future appreciation of dollar would cause the current spot rate of dollar to appreciate. The decline in the current U.S. interest rate is providing a signal about the future, which through the expected exchange rate, affects the current spot rate. Hence, as the expectation of the future economy varies, we would expect to see different announcement reaction patterns, even within the similar recession status. Meanwhile, we expect the exchange rate reactions to vary across currencies given the same time horizon, depending on how the market perceives different countries' central banks would respond to the state of the economy.

We can also expect the time-varying and currency-dependency nature of announcement reactions using the portfolio reallocation theory in Ding and Ma (2010). Their main idea is that the fundamentals must influence the exchange rate through the financial markets. The direction of the relationship between financial variables and the exchange rate dynamics varies in different regimes, due to the change of phase of the business cycle and the higher-return-currency in the financial market. The relationship varies across currencies and time even within the similar business cycle status. This implies that even within the recession

status, the same expansionary policy news can cause different effects in the foreign exchange market at different periods of recession. Meanwhile, different currencies might have different response to the same news announcement within a certain time period.

The Federal Open Market Committee uses the federal funds target rate as its most potent monetary tool for regulating the U.S. economy. The hypothesis I am testing is whether the federal funds target rate announcements have significant effects on exchange rate responses. My theoretical estimation equation is:

$$R_t = \beta_0 + \beta_1 S_t + \varepsilon_t \qquad (1)$$

where R_t is the 5-minute exchange rate return and S_t is the unexpected target rate change in percentage points on day t. The null hypothesis is that the sign of β_1 is the same across currencies and across different stages of the business cycle. The alternative hypothesis is that the sign of β_1 varies across currencies and across different stages of the business cycle. The violation of the null hypothesis would suggest that exchange rates movements in response to U.S. monetary policy are in fact time-varying and currency-dependent.

4. Data

I analyze the relationship between the exchange rate market and U.S. monetary policy by using high-frequency data from the period 3 January 2001 to 15 March 2011. I study spot exchange rates for the following currency pairs: the CAD, CHF, GBP, JPY and EUR vs. the USD.[2] The minute-by-minute data is calculated from the tick-by-tick exchange rate quotes obtained from GAIN Capital Group.[3] All exchange rates are measured as units of dollar per

[2] CAD– Canadian Dollar, CHF– Swiss Franc, GBP– British Pound, JPY– Japanese Yen, EUR– Euro and USD – US Dollar

[3] GAIN Capital Group is a leading provider of online foreign exchange trading services. Minute t exchange rate is the average of the last ask and bid quotes in the time interval (t-1, t).

foreign currency so than an increase in the exchange rate is an appreciation of the foreign currency and a depreciation of the dollar.

The Federal Open Market Committee (FOMC) holds eight regularly scheduled meetings a year, with additional unscheduled meetings as needed. Any changes in the federal funds target rate are announced after the meeting. Since 1994, the Fed has started announcing target rate changes routinely at 2:15pm Eastern time.

Changes in the federal funds target rate measure the actual monetary policy changes, but expectations of federal policy changes are not directly observable. Empirical studies have found the federal funds futures prices a useful proxy for changes in monetary policy expectations, as suggested by Krueger and Kuttner (1996), Kuttner (2001), and Hamilton (2007). Kuttner (2001) computes the policy surprise from the one-day change in the spot-month futures rate. The key point is that the day (t-1) futures rate incorporates the expected change on (or after) day t. If the federal funds target rate on day t changes as expected, the spot rate will remain unchanged. Otherwise, the futures rate on day t will change, by an amount proportional to the number of days affected by the change. The one-day policy surprise for day t is measured as $\frac{m}{m-t}\ (f_{s,t} - f_{s,t-1})$, where m is the number of days in the month and $f_{s,t}$ is the spot-month futures rate on day t of month s. The expected part of policy change is computed by subtracting the one-day policy surprise from the corresponding federal funds target rate.

Table A exhibits the 97 monetary policy announcements during the 2001-2011 time-period, including both scheduled and unscheduled ones. The timing of the U.S. economic expansions and recessions is adopted from the Business Cycle Dating Committee

of the National Bureau of Economic Research. The first recession during this period is from April 2001 to November 2001, corresponding to announcement events 4 to 10. The second recession started in January 2008 and ended in June 2009, which corresponds to announcement events 63 to 82.

Figure 1 graphs the values of the 5-minute exchange rate returns and the values of the actual and the surprise component of the federal funds target rate changes. The exchange rate returns seem to follow a random walk during periods of expansion: no specific pattern is observed between the movements of exchange rate return and the monetary policy surprise. Interesting things happen within the two recessions when expansionary policy was applied. The burst of the dot-com bubble and the terrorist attack led to a market downturn in the year 2001. The movements of exchange rate returns and policy surprises seem to be negatively correlated in response to government's stimulus policy. In the recession of 2008 the movements of the two seem to move together except for the JPY which exhibits negative correlation.

Exchange rate responses appear to depend on currency-pair as well, especially during recessions. The 50 basis point cut on October 29th, 2008 contained a very large surprise component (announcement event 75). A close look at this event finds that the JPY appreciated while all other currencies depreciated against the USD following the announcement release. One possible explanation for this is that the Fed's action signaled the possibility of a market downturn and in order to better manage risks investors dumped risky foreign assets and increased the holding of the USD. On the other hand, given the interest rate in Japan still being lower than their U.S. counterparts, the decrease in interest rate differential between the

JPY and the USD attracted some dollars into the Japanese market, giving rise to an appreciation of the JPY.

Figure 2 plots the ratio of the 5-minute exchange rate changes right after each announcement to the changes in the federal funds target rate surprise.[4] A positive value indicates a positive relationship between exchange rate movement and the monetary policy surprise. The exchange rate movements are significant in the periods of two recessions and year 2004 when the Fed switched from expansionary monetary policy to contractionary monetary policy.

In summary, preliminary results suggest that exchange rate responses to U.S. monetary policy appear to depend on the stages of the business cycle and the currency-pair. Formal regressions are needed to test for this time-varying and currency-dependent pattern.

5. Regression results and discussion

Using an event study approach, I model the response of the 5-min exchange rate return, R_t, as a linear function of the lagged value of exchange rate return itself, R_{t-1}, and the federal funds target rate surprise variable S_t. The efficient markets hypothesis (EMH) shows that asset prices should respond immediately to the surprise component of any announcement. Moreover, according to the EMH, the most recent price (t-1) contains all the information about the market and should be incorporated in the current price (t). Therefore, I use the lagged value of exchange rate return to capture the market dynamics before the monetary policy announcement. At the time of release, a U.S. monetary policy announcement should have a dominant impact compared to other news announcements.

[4] The value of the exchange rate change itself is used when the surprise component of the federal funds target rate change is zero.

To observe any time-variation and currency-dependency of the news effect, I model the exchange rate returns for individual currency, under which the sample is further divided into different states of economy. My guiding estimation equation is:

$$R_{t(i,k)} = \beta_0 + \beta_1 R_{t(i,k)-1} + \beta_2 S_{t(i,k)} + \varepsilon_{t(i,k)} \qquad (2)$$

i=observations in recession 1 and recession 2, k=observations in five major currencies

I estimate Equation (2) with five different event windows: (0, 5min), (0, 10min), (0, 20min), (0, 30min), and (0,45min), within which I include observations of successive five-minute intervals after each announcement. Since I am interested in the direction of exchange rate movement as the sign of policy surprise switches, I only include non-zero surprises in my regression.

Table 1-5 shows the regression results under this linear OLS estimation. In the 2001 recession, the exchange rates in general respond negatively to the monetary surprises, except for the CAD, which shows a positive relationship in the (0, 5min) window. In other words, a Fed inflationary policy (a federal funds rate cut) leads to a depreciation of dollar and an appreciation of the foreign currency, except for the CAD. Exchange rates show significant responses to monetary surprises within 10 minutes after the announcement. The effects of news disappear when measured at the 20-minute event window or longer.

Currencies exhibit a different reaction pattern in the 2007-09 recession. The exchange rates show slower responses to monetary news surprises, giving a significant reaction in the (0, 20min) window or longer. Moreover, the exchange rates exhibit positive responses to monetary surprise, which indicates that Fed funds rate cut is associated with dollar appreciation.

The linear estimations have strong explanatory power for the CAD, CHF, EUR and GBP, but show no obvious reaction patterns for the JPY. Past literature (Rossi 2005, Sarno and Valente 2009) suggests the possibility of non-linear relationship between the exchange rate and macro fundamentals. Based on data observation and past literature, I tested the same parameters with a non-linear model specification. I only include non-zero surprises in my regression. As the surprise variable takes both positive and negative values, and the log function can affect the signs of the values, I apply the corresponding signs after taking log of my surprise variable.

$$R_{t(i,k)} = \begin{cases} \beta_0 + \beta_1 R_{t(i,k)-1} + \beta_2 \log|S_{t(i,k)}| + \varepsilon_{t(i,k)} \text{ if } (|S_{t(i,k)}|<=1 \ \& \ S_{t(i,k)}<0) \text{ or } (|S_{t(i,k)}|>1 \ \& \ S_{t(i,k)}>0) \\ \beta_0 + \beta_1 R_{t(i,k)-1} - \beta_2 \log|S_{t(i,k)}| + \varepsilon_{t(i,k)} \text{ if } (|S_{t(i,k)}|<=1 \ \& \ S_{t(i,k)}>0) \text{ or } (|S_{t(i,k)}|>1 \ \& \ S_{t(i,k)}<0) \end{cases}$$

i=observations in recession 1 and recession 2, k=observations in five major currencies (3)

where S_t, the federal funds target rate surprise, is measured in basis point (100*percentage point).

I show the estimation results in Table 6-10, which contains a number of noteworthy features. First, as we observed in the linear regression, the 2001 recession shows negative correlation between exchange rate response and monetary surprise. The CAD continues to have a positive coefficient for news surprise variable in the (0, 5min) regression window. As the event window becomes larger, the coefficient turns negative, consistent with other currencies such as the CHF and the EUR. Interestingly, both the linear and non-linear regressions indicate that only the CAD, CHF, and EUR show significance in reaction to news surprise in the 2001 recession. Second, currencies respond positively to monetary news surprises in the 2007-09 recession except for the JPY, which gives significantly negative

coefficient on the news surprise variable.

This makes sense, as the 2007-09 recession had a stronger global impact compared to the 2001 recession. Investors thus had different expectations of "global actions" following changes in Federal Reserve policy in the 2007-09 recession. We infer that investors adjusted their portfolios based on not only the U.S. monetary news released but also the expectations of the moves of other major central banks in the world. The inflationary Fed funds policy leads to the expectation of interest rate cut from other central banks, and thus investors do not necessarily dump dollars following the Fed funds cut. When the expected interest rate cut in foreign countries' central banks exceeds the Fed funds rate cut, the USD would appreciate against foreign currencies, and we would see positive currency responses to monetary news surprises in the recession.

The JPY is an exception among these major currencies. The market interest rate was very close to zero during the recession period, and thus there was little expectation for the Bank of Japan to lower interest rates. A Fed funds rate cut decreased the interest rate differential between the USD and the JPY. Investors reallocated their portfolios by buying more Japanese assets. Thus, the JPY appreciated and the USD depreciated in the 2007-09 recession.

6. Robustness Check

Given the small sample size in both our baseline and non-linear estimations, I re-estimate the two models by pooling all five currencies into one sample and introduce *Country* as a dummy variable to observe any currency deviation from the average. Again, the regressions are run under the 2001 recession and the 2007-09 recession separately.

$$R_{t(i,k)} = \beta_0 + \beta_1 R_{t(i,k)-1} + \beta_2 S_{t(i,k)} + \beta_3 Country + \beta_4 (S_{t(i,k)} * Country) + \varepsilon_{t(i,k)} \qquad (4)$$

All parameters in the previous linear model are carried over. *Country* is a dummy variable, giving 1 for the currency under measure and 0 for all other four currencies. The dummy variable and the interaction term are also added to the non-linear model. I show results of both two models in table 11 and 12.

The coefficient on $S_{t(i,k)}$ indicates the average level of exchange rate changes among four other currencies (excluding the currency under measure), given one unit of change in monetary surprises. For instance, in the 2001 recession, a one-percent decrease in the surprise component of Fed funds target rate is associated with an average of 0.222 percent appreciation of the JPY, CHF, EUR and GBP after 10 minutes of the announcement. Consistent with our baseline regressions, foreign currencies appreciate in response to the Fed funds rate cut in the 2001 recession, and the reaction is generally complete within 10 minutes of the announcement. The reaction is significant for all five currencies under consideration.

In contrast, foreign currencies depreciate in response to the Fed inflationary policy in the 2007-09 recession, with a significant reaction at event windows of 20 minutes or longer. The JPY is an exception in the above currency behavior. The significantly negative interaction terms in the non-linear estimations suggest a currency appreciation associated with the Fed funds rate cut. For instance, in the 2007-09 recession, the JPY has a 0.015 percent appreciation following one percent decrease in the Fed funds rate, whereas all other currencies show an average of 0.021 percent depreciation.

The CHF also exhibits significant currency deviation from other currencies in the 2001 recession, in regards to magnitude; however, the direction of exchange rate movement is still consistent with other currencies. Hence, it is safe to conclude that our findings of the

regime-switching nature of exchange rate are robust.

7. Conclusion

In this paper, I examine eleven years of high-frequency exchange rate data and their relationship with U.S. monetary policy news surprises. The sample period under study is more inclusive than the existing literature in that it contains both the 2001 recession and the 2007-09 recession. Five currency pairs are examined: the CAD, CHF, GBP, JPY and EUR vs. the USD. Regression results show that exchange rates do exhibit time-varying and currency-dependent nature following the U.S. monetary policy news announcements. Within the recession phase of the business cycle, exchange rate responses show different reaction patterns in the 2001 recession and the 2007-09 recession. In the 2001 recession, foreign currencies appreciate and the dollar depreciates following the Fed funds rate cut, with the CAD, CHF and EUR giving the most significant responses. In the 2007-09 recession, foreign currencies depreciate against the dollar in response to the monetary surprises, except for the JPY.

The exchange rate movements are related to the market's expectations of interest rate movements of the major central banks around the world. If the foreign country's central bank is expected to cut interest rate following the Fed funds rate cut, the direction of exchange rate movement depends on the expected interest rate differential. The 2007-09 recession had a stronger global impact compared to the 2001 recession, and thus we see distinct expectations of interest rate differential and exchange rate responses following the news announcement. However, the JPY has completely different dynamics for the same time period. The change in interest rate differential appears to be the driving factor of the difference, as Bank of Japan

maintains a close-to-zero interest rate which leads to the USD being the higher-return-currency after the Fed funds rate cut. This result is consistent with findings reported by Ding and Ma (2010).

I further find that exchange rates tend to respond more quickly in the 2001 recession, within the first 10 minutes. In the 2007-09 recession, significant responses are seen in the event window (0, 20min) or longer. Moreover, the CAD, CHF, EUR and GBP exhibit linear relationships with monetary policy surprises, while the JPY shows non-linear correlations with the news surprises.

A key direction for future research is to push farther with the theoretical mechanism underlying the time-varying and currency-dependent exchange rate nature following monetary news release. Ding and Ma (2010) propose a portfolio reallocation theory that explains the regime-switching nature of exchange rate dynamics. It may be well applied to the news effects on high frequency exchange rate data. The underlying financial variables that affect the process include the interest rate differential, cross risk premium (i.e. comparison between foreign stock market return and domestic bond market return), investors' risk appetite and expected market risk. I use the interest rate differential as the main driving factor of regime-switch in this paper. Future research can perform empirical tests on all the underlying financial variables to examine the mechanism under the time-varying and currency-dependent exchange rate response.

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Table A

U.S. Monetary Policy Announcements

Event	Year	Date	Actual Change (%)	Surprise Component (%)
1	2001	10301	-0.5	-0.382
2		13101	-0.5	0.005
3		32001	-0.5	0.056
4		41801	-0.5	-0.425
5		51501	-0.5	-0.078
6		62701	-0.25	0.050
7		82101	-0.25	0.016
8		91701	-0.5	-0.323
9		100201	-0.5	-0.069
10		110601	-0.5	-0.100
11		121101	-0.25	0.000
12	2002	13002	0	0.000
13		31902	0	-0.026
14		50702	0	0.000
15		62602	0	0.000
16		81302	0	0.034
17		92402	0	0.025
18		110602	-0.5	-0.194
19		121002	0	0.000
20	2003	12903	0	0.000
21		31803	0	0.048
22		50603	0	0.037
23		62503	-0.25	0.150
24		81203	0	0.000
25		91603	0	0.000
26		102803	0	0.000
27		120903	0	0.000
28	2004	12804	0	0.000
29		31604	0	0.000
30		50404	0	-0.006
31		63004	0.25	-0.010
32		81004	0.25	0.022
33		92104	0.25	0.017
34		111004	0.25	0.000
35		121404	0.25	0.000
36	2005	20205	0.25	0.000
37		32205	0.25	0.000
38		50305	0.25	0.000
39		63005	0.25	0.000
40		80905	0.25	0.000

Table A (continued)

U.S. Monetary Policy Announcements

Event	Year	Date	Actual Change (%)	Surprise Component (%)
41		92005	0.25	0.015
42		110105	0.25	0.000
43		121305	0.25	0.000
44	2006	13106	0.25	0.000
45		32806	0.25	0.000
46		51006	0.25	-0.007
47		62906	0.25	-0.150
48		80806	0	-0.040
49		92006	0	0.000
50		102506	0	0.000
51		121206	0	0.000
52	2007	13107	0	0.000
53		32107	0	0.000
54		50907	0	0.000
55		62807	0	0.000
56		80707	0	0.026
57		81007	0	0.000
58		81607	0	-0.021
59		91807	-0.25	-0.150
60		103107	-0.25	-0.020
61		120607	0	0.005
62		121107	-0.5	0.008
63	2008	10908	0	0.000
64		12208	-0.75	-0.741
65		13008	-0.5	0.000
66		31008	0	0.022
67		31808	-0.75	0.167
68		43008	-0.25	-0.055
69		62508	0	-0.030
70		72408	0	0.000
71		80508	0	-0.006
72		91608	0	0.059
73		92908	0	-0.075
74		100808	-0.5	-0.142
75		102908	-0.5	-0.426
76		121608	-0.75	0.061
77	2009	11609	0	0.005
78		12809	0	0.000
79		31809	0	-0.006
80		42909	0	0.000

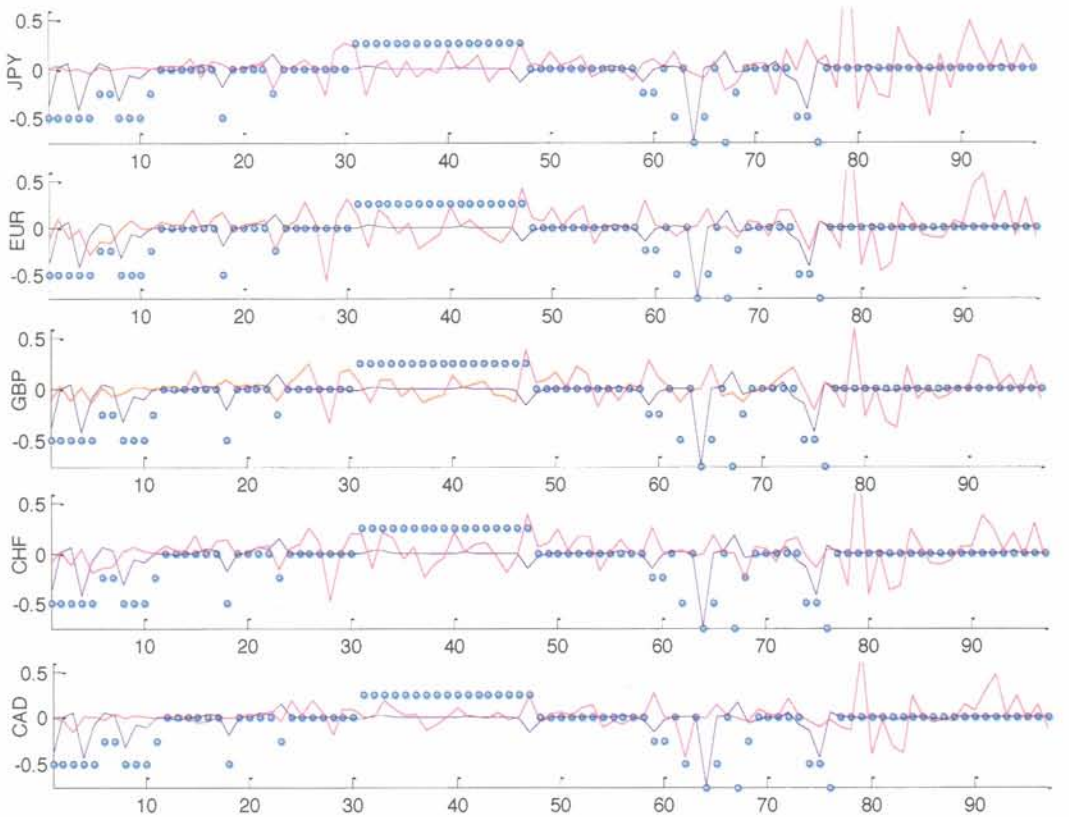
Table A (continued)

U.S. Monetary Policy Announcements

Event	Year	Date	Actual Change (%)	Surprise Component (%)
81		60309	0	0.006
82		62409	0	-0.025
83		81209	0	-0.008
84		92309	0	0.000
85		110409	0	0.000
86		121609	0	-0.010
87	2010	12710	0	-0.019
88		31610	0	0.000
89		42810	0	0.000
90		62310	0	0.000
91		81010	0	0.000
92		92110	0	0.000
93		101510	0	0.000
94		110310	0	0.003
95		121410	0	0.000
96	2011	12611	0	0.000
97		31511	0	0.000

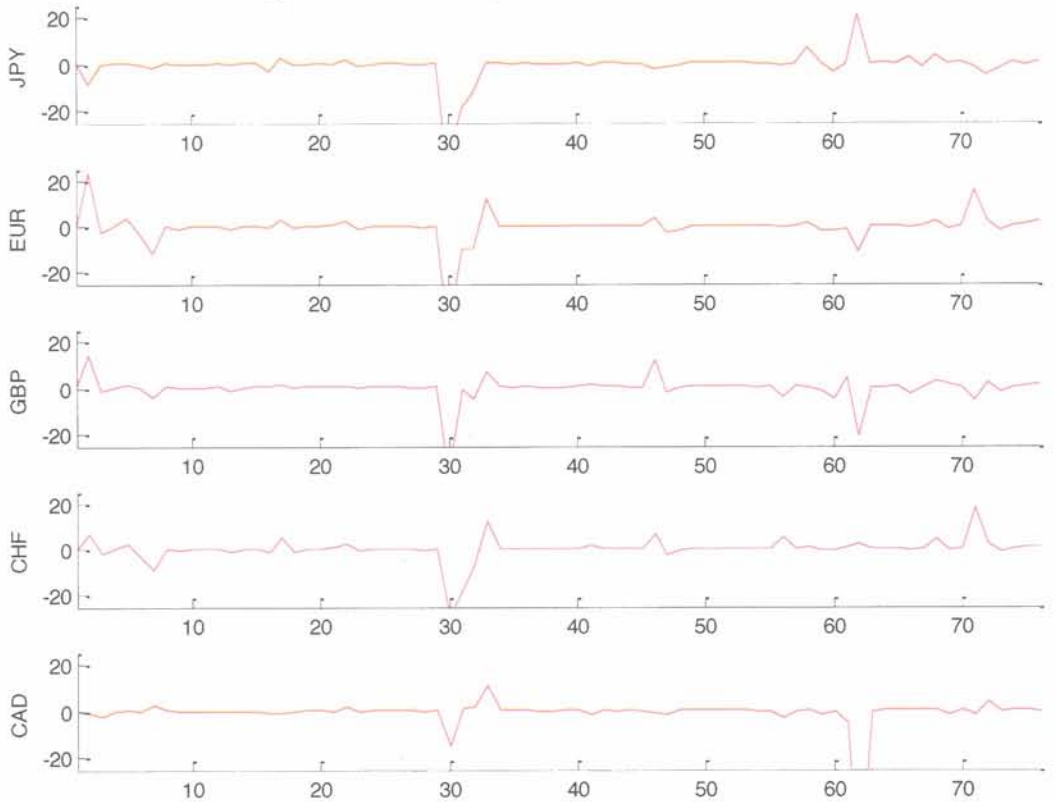
Notes: Announcement Date is in the format MDDYY. Actual changes and the surprise component of the actual changes of U.S. monetary policy are in percentage points.

Figure 1: Announcements and Exchange Rate Returns



Notes: Figure 1 graphs the values of the 5-minute exchange rate returns after announcements and the values of the actual and the surprise component of the federal funds target rate changes. They are percentage points. The horizontal axis is the announcement event as displayed in Table I.

Figure 2: Ratio of Exchange Return to the Annoucement Surprise



Notes: Figure 2 plots the ratio of the 5-minute exchange rate returns right after each announcement to the changes in the federal funds target rate surprise. The horizontal axis is the announcement event as displayed in Table I. The announcements are displayed until the end of year 2008, as the news surprises are mostly zero after that, making the ratio not meaningful.

Baseline Model: Linear regressions

Table 1(a): 5 Currencies: Exchange Rate Responses to the Fed Funds Target rate Surprise

Linear estimations, 5-minute returns in (0,5min) window

Recession I: April 2001 - November 2001

Variable Name	CAD/$	CHF/$	EUR/$	GBP/$	JPY/$
Intercept	0.029***	-0.049	-0.027	-0.036	0.000
	(6.11)	(-0.86)	(-0.66)	(-0.85)	(-0.08)
FFT-Surprise	0.131***	-0.544*	-0.568**	-0.098	0.007
	(5.53)	(-2.45)	(-3.31)	(-0.45)	(0.12)
R[t-1]	0.691***	-4.303	-4.598**	-0.468	0.260
	(5.84)	(-1.44)	(-3.63)	(-0.32)	(1.24)
Observations	7	7	7	7	7
R-squared	0.907	0.601	0.809	0.050	0.277

t statistics in parentheses; *** significance at 1%, ** significance at 5%,
* significance at 10% level

Table 1(b): 5 Currencies: Exchange Rate Responses to the Fed Funds Target rate Surprise

Linear estimations, 5-minute returns in (0,5min) window

Recession II: January 2008 - June 2009

Variable Name	CAD/$	CHF/$	EUR/$	GBP/$	JPY/$
Intercept	0.031	0.020	0.046	0.018	0.137
	(0.45)	(0.25)	(0.46)	(0.31)	(1.24)
FFT-Surprise	0.095	0.217	0.142	0.072	0.274
	(0.31)	(0.62)	(0.32)	(0.27)	(0.57)
R[t-1]	-0.343	-1.984*	-0.490	-0.580	-1.11*
	(-0.55)	(-2.05)	(-0.63)	(-0.92)	(-1.84)
Observations	15	15	15	15	15
R-squared	0.044	0.274	0.052	0.087	0.222

t statistics in parentheses; *** significance at 1%, ** significance at 5%,
* significance at 10% level

Table 2(a): 5 Currencies: Exchange Rate Responses to the Fed Funds Target rate Surprise

Linear estimations, 5-minute returns in (0,10 min) window

Recession I: April 2001 - November 2001

Variable Name	CAD/$	CHF/$	EUR/$	GBP/$	JPY/$
Intercept	-0.008	-0.090**	-0.116***	-0.039*	-0.032*
	(-0.53)	(-0.86)	(-3.16)	(-1.84)	(-1.84)
FFT-Surprise	-0.080	-0.348**	-0.319*	-0.067	-0.086
	(-1.11)	(-2.40)	(-1.88)	(-0.70)	(-1.08)
R[t-1]	0.212	-0.528*	-0.433†	-0.065	0.103
	(0.48)	(-1.78)	(-1.53)	(-0.17)	(0.28)
Observations	14	14	14	14	14
R-squared	0.149	0.370	0.294	0.043	0.104

t statistics in parentheses; *** significance at 1%, ** significance at 5%, * significance at 10% level,
† significance at 15% level

Table 2(b): 5 Currencies: Exchange Rate Responses to the Fed Funds Target rate Surprise

Linear estimations, 5-minute returns in (0,10 min) window

Recession II: January 2008 - June 2009

Variable Name	CAD/$	CHF/$	EUR/$	GBP/$	JPY/$
Intercept	0.033	0.062	0.073	0.048	0.098†
	(0.81)	(1.21)	(1.31)	(1.23)	(1.60)
FFT-Surprise	0.171	0.224	0.260	0.158	0.107
	(0.95)	(1.01)	(1.07)	(0.94)	(0.41)
R[t-1]	-0.163	-0.121	0.001	0.305	-0.272
	(-0.73)	(-0.56)	(0.01)	(1.27)	(-1.41)
Observations	30	30	30	30	30
R-squared	0.051	0.044	0.041	0.086	0.071

t statistics in parentheses; *** significance at 1%, ** significance at 5%, * significance at 10% level,
† significance at 15% level

Table 3(a): 5 Currencies: Exchange Rate Responses to the Fed Funds Target rate Surprise

Linear estimations, 5-minute returns in (0,20 min) window

Recession I: April 2001 - November 2001

Variable Name	CAD/$	CHF/$	EUR/$	GBP/$	JPY/$
Intercept	-0.001	-0.014	-0.021	-0.005	-0.032
	(-0.13)	(-0.55)	(-0.67)	(-0.34)	(-1.84)
FFT-Surprise	-0.057	-0.066	0.046	0.010	-0.086
	(-0.97)	(-0.53)	(-0.31)	(0.15)	(-1.08)
R[t-1]	0.249	-0.149	-0.186	-0.024	0.103
	(1.12)	(-0.62)	(-0.80)	(-0.10)	(0.28)
Observations	28	28	28	28	28
R-squared	0.147	0.023	0.027	0.002	0.013

t statistics in parentheses; *** significance at 1%, ** significance at 5%, * significance at 10% level

Table 3(b): 5 Currencies: Exchange Rate Responses to the Fed Funds Target rate Surprise

Linear estimations, 5-minute returns in (0,20 min) window

Recession II: January 2008 - June 2009

Variable Name	CAD/$	CHF/$	EUR/$	GBP/$	JPY/$
Intercept	0.033	0.063**	0.06*	0.049*	0.098**
	(1.25)	(2.13)	(1.89)	(1.91)	(1.60)
FFT-Surprise	0.168†	0.22*	0.243*	0.162†	0.107
	(1.48)	(1.73)	(1.78)	(1.45)	(0.41)
R[t-1]	-0.34**	0.040	0.064	0.311**	-0.272
	(-2.33)	(0.29)	(0.47)	(2.00)	(-1.41)
Observations	60	60	60	60	60
R-squared	0.113	0.056	0.061	0.107	0.034

t statistics in parentheses; *** significance at 1%, ** significance at 5%, * significance at 10% level,
† significance at 15% level

Table 4(a): 5 Currencies: Exchange Rate Responses to the Fed Funds Target rate Surprise

Linear estimations, 5-minute returns in (0,30 min) window

Recession I: April 2001 - November 2001

Variable Name	CAD/$	CHF/$	EUR/$	GBP/$	JPY/$
Intercept	-0.002	0.000	0.003	0.003	0.002
	(-0.31)	(-0.03)	(0.14)	(0.26)	(0.14)
FFT-Surprise	-0.045	-0.017	0.010	0.014	0.007
	(-1.17)	(-0.19)	(0.10)	(0.29)	(0.13)
R[t-1]	0.223	-0.112	-0.053	0.030	0.086
	(1.43)	(-0.660)	(-0.32)	(0.18)	(0.54)
Observations	42	42	42	42	42
R-squared	0.115	0.012	0.003	0.003	0.008

t statistics in parentheses; *** significance at 1%, ** significance at 5%, * significance at 10% level

Table 4(b): 5 Currencies: Exchange Rate Responses to the Fed Funds Target rate Surprise

Linear estimations, 5-minute returns in (0,30 min) window

Recession II: January 2008 - June 2009

Variable Name	CAD/$	CHF/$	EUR/$	GBP/$	JPY/$
Intercept	0.029	0.042**	0.045**	0.036**	0.046*
	(-1.51)	(2.00)	(2.05)	(1.92)	(1.76)
FFT-Surprise	0.110	0.135†	0.138†	0.098	0.031
	(1.32)	(1.48)	(1.45)	(1.20)	(0.28)
R[t-1]	-0.213**	0.015	0.052	0.082	-0.226**
	(-2.01)	(0.14)	(0.50)	(0.78)	(-2.23)
Observations	90	90	90	90	90
R-squared	0.058	0.026	0.029	0.026	0.054

t statistics in parentheses; *** significance at 1%, ** significance at 5%,

* significance at 10% level, † significance at 15% level

Table 5(a): 5 Currencies: Exchange Rate Responses to the Fed Funds Target rate Surprise

Linear estimations, 5-minute returns in (0,45 min) window

Recession I: April 2001 - November 2001

Variable Name	CAD/$	CHF/$	EUR/$	GBP/$	JPY/$
Intercept	0.000	-0.001	0.001	0.000	0.000
	(0.06)	(-0.07)	(0.05)	(0.05)	(-0.046)
FFT-Surprise	-0.028	-0.036	0.009	0.017	0.011
	(-1.00)	(-0.56)	(0.12)	(0.46)	(0.29)
R[t-1]	0.215*	-0.096	-0.087	0.054	0.032
	(1.73)	(-0.74)	(-0.67)	(0.41)	(0.25)
Observations	63	63	63	63	63
R-squared	0.076	0.013	0.008	0.006	0.002

t statistics in parentheses; *** significance at 1%, ** significance at 5%,
* significance at 10% level

Table 5(b): 5 Currencies: Exchange Rate Responses to the Fed Funds Target rate Surprise

Linear estimations, 5-minute returns in (0,45 min) window

Recession II: January 2008 - June 2009

Variable Name	CAD/$	CHF/$	EUR/$	GBP/$	JPY/$
Intercept	0.028**	0.026*	0.032**	0.025**	0.012
	(2.00)	(1.74)	(2.08)	(1.95)	(0.63)
FFT-Surprise	0.111*	0.074	0.099†	0.085†	-0.015
	(1.85)	(1.15)	(1.48)	(1.53)	(-0.18)
R[t-1]	-0.182**	0.054	0.043	0.084	-0.168**
	(-2.18)	(0.62)	(0.50)	(0.99)	(-1.99)
Observations	135	135	135	135	135
R-squared	0.054	0.014	0.020	0.026	0.029

t statistics in parentheses; *** significance at 1%, ** significance at 5%,
* significance at 10% level, † significance at 15% level

Methodology 2: Non-linear regressions

Table 6(a): 5 Currencies: Exchange Rate Responses to the Fed Funds Target rate Surprise

Non-linear estimations, 5-minute returns in (0,5min) window

Recession I: April 2001 - November 2001

Variable Name	CAD/$	CHF/$	EUR/$	GBP/$	JPY/$
Intercept	0.032**	-0.118**	-0.128*	-0.05†	-0.005
	(3.05)	(-2.94)	(-2.31)	(-1.76)	(-0.63)
FFT-Surprise	0.011**	-0.038†	-0.033	-0.009	-0.001
	(2.61)	(-1.90)	(-1.22)	(-0.79)	(-0.35)
R[t-1]	0.784**	-0.540	-0.570	-0.827	0.34†
	(3.05)	(-0.67)	(-0.74)	(-1.00)	(1.82)
Observations	7	7	7	7	7
R-squared	0.702	0.502	0.271	0.258	0.453

t statistics in parentheses; *** significance at 1%, ** significance at 5%,
* significance at 10% level, † significance at 15% level

Table 6(b): 5 Currencies: Exchange Rate Responses to the Fed Funds Target rate Surprise

Non-linear estimations, 5-minute returns in (0,5min) window

Recession II: January 2008 - June 2009

Variable Name	CAD/$	CHF/$	EUR/$	GBP/$	JPY/$
Intercept	0.029	0.032	0.065	0.029	0.153*
	(0.43)	(0.40)	(0.71)	(0.55)	(1.68)
FFT-Surprise	0.009	0.010	0.005	0.003	-0.030
	(0.29)	(0.26)	(0.11)	(0.14)	(-1.22)
R[t-1]	-0.357	-1.58†	-0.430	-0.540	-0.94*
	(-0.58)	(-1.50)	(-0.56)	(-0.92)	(-1.84)
Observations	15	15	15	15	15
R-squared	0.042	0.171	0.037	0.087	0.319

t statistics in parentheses; *** significance at 1%, ** significance at 5%,
* significance at 10% level, † significance at 15% level

Table 7(a): 5 Currencies: Exchange Rate Responses to the Fed Funds Target rate Surprise

Non-linear estimations, 5-minute returns in (0,10 min) window

Recession I: April 2001 - November 2001

Variable Name	CAD/$	CHF/$	EUR/$	GBP/$	JPY/$
Intercept	-0.016	-0.115***	-0.127***	-0.051**	-0.014
	(-1.04)	(-4.0)	(-3.78)	(-2.70)	(-1.00)
FFT-Surprise	-0.011*	-0.038***	-0.028**	-0.007	-0.006
	(-1.74)	(-3.29)	(-2.18)	(-0.90)	(-1.13)
R[t-1]	0.018	-0.558*	-0.440†	-0.110	0.247
	(0.04)	(-1.98)	(-1.68)	(-0.36)	(0.61)
Observations	14	14	14	14	14
R-squared	0.257	0.497	0.331	0.072	0.118

t statistics in parentheses; *** significance at 1%, ** significance at 5%,

* significance at 10% level, † significance at 15% level

Table 7(b): 5 Currencies: Exchange Rate Responses to the Fed Funds Target rate Surprise

Non-linear estimations, 5-minute returns in (0,10 min) window

Recession II: January 2008 - June 2009

Variable Name	CAD/$	CHF/$	EUR/$	GBP/$	JPY/$
Intercept	0.031	0.067	0.066	0.040	0.134**
	(0.76)	(1.42)	(1.27)	(1.12)	(2.37)
FFT-Surprise	0.018	0.024	0.026	0.012	-0.014
	(0.92)	(-0.35)	(1.06)	(0.66)	(-0.90)
R[t-1]	-0.164	-0.076	0.075	0.394†	-0.332*
	(-0.74)	(-0.35)	(0.35)	(1.60)	(-1.72)
Observations	30	30	30	30	30
R-squared	0.049	0.044	0.043	0.100	0.110

t statistics in parentheses; *** significance at 1%, ** significance at 5%,

* significance at 10% level, † significance at 15% level

Table 8(a): 5 Currencies: Exchange Rate Responses to the Fed Funds Target rate Surprise

Non-linear estimations, 5-minute returns in (0,20 min) window

Recession I: April 2001 - November 2001

Variable Name	CAD/$	CHF/$	EUR/$	GBP/$	JPY/$
Intercept	-0.010	0.004	0.002	-0.009	0.004
	(-0.86)	(0.17)	(0.071)	(-0.56)	(0.314)
FFT-Surprise	-0.01*	0.001	0.003	0.000	-0.002
	(-1.86)	(0.12)	(0.28)	(0.03)	(-0.42)
R[t-1]	0.090	0.075	0.027	-0.041	0.073
	(0.38)	(0.30)	(0.11)	(-0.16)	(0.28)
Observations	28	28	28	28	28
R-squared	0.222	0.004	0.003	0.001	0.013

t statistics in parentheses; *** significance at 1%, ** significance at 5%,
* significance at 10% level

Table 8(b): 5 Currencies: Exchange Rate Responses to the Fed Funds Target rate Surprise

Non-linear estimations, 5-minute returns in (0,20 min) window

Recession II: January 2008 - June 2009

Variable Name	CAD/$	CHF/$	EUR/$	GBP/$	JPY/$
Intercept	0.030	0.065**	0.057**	0.046*	0.100***
	(1.16)	(2.38)	(1.94)	(1.87)	(2.96)
FFT-Surprise	0.017†	0.023*	0.0243*	0.015	-0.016*
	(1.41)	(1.77)	(1.74)	(1.27)	(-1.82)
R[t-1]	-0.33**	0.073	0.107	0.344**	-0.248*
	(-2.30)	(0.54)	(0.43)	(2.21)	(-1.81)
Observations	60	60	60	60	60
R-squared	0.109	0.063	0.065	0.108	0.095

t statistics in parentheses; *** significance at 1%, ** significance at 5%,
* significance at 10% level, † significance at 15% level

Table 9(a): 5 Currencies: Exchange Rate Responses to the Fed Funds Target rate Surprise

Non-linear estimations, 5-minute returns in (0,30 min) window

Recession I: April 2001 - November 2001

Variable Name	CAD/$	CHF/$	EUR/$	GBP/$	JPY/$
Intercept	-0.007	0.010	0.015	0.009	0.003
	(-0.93)	(0.55)	(0.71)	(0.69)	(0.34)
FFT-Surprise	-0.007*	0.001	0.003	0.003	-0.001
	(-1.94)	(0.16)	(0.35)	(0.56)	(-0.17)
R[t-1]	0.137	-0.017	0.038	-0.003	0.067
	(0.85)	(-0.10)	(0.23)	(-0.01)	(0.40)
Observations	42	42	42	42	42
R-squared	0.164	0.001	0.004	0.008	0.005

t statistics in parentheses; *** significance at 1%, ** significance at 5%,
* significance at 10% level

Table 9(b): 5 Currencies: Exchange Rate Responses to the Fed Funds Target rate Surprise

Non-linear estimations, 5-minute returns in (0,30 min) window

Recession II: January 2008 - June 2009

Variable Name	CAD/$	CHF/$	EUR/$	GBP/$	JPY/$
Intercept	0.028†	0.047**	0.047**	0.034*	0.065***
	(1.47)	(2.43)	(2.26)	(1.92)	(2.63)
FFT-Surprise	0.012	0.140†	0.014†	0.008	-0.01†
	(1.33)	(1.49)	(1.46)	(0.97)	(-1.47)
R[t-1]	-0.214**	0.026	0.070	0.094	-0.249***
	(-2.03)	(0.24)	(0.68)	(0.90)	(-2.49)
Observations	90	90	90	90	90
R-squared	0.058	0.027	0.032	0.022	0.054

t statistics in parentheses; *** significance at 1%, ** significance at 5%,
* significance at 10% level, † significance at 15% level

Table 10(a): 5 Currencies: Exchange Rate Responses to the Fed Funds Target rate Surprise

Non-linear estimations, 5-minute returns in (0,45 min) window

Recession I: April 2001 - November 2001

Variable Name	CAD/$	CHF/$	EUR/$	GBP/$	JPY/$
Intercept	-0.002	0.016	0.018	0.006	0.001
	(-0.27)	(1.19)	(1.15)	(0.64)	(0.21)
FFT-Surprise	-0.004	0.003	0.006	0.003	0.003
	(-1.38)	(0.54)	(0.93)	(0.75)	(0.97)
R[t-1]	0.185†	0.010	0.037	-0.102	0.128
	(1.46)	(0.08)	(0.29)	(-0.79)	(1.01)
Observations	63	63	63	63	63
R-squared	0.089	0.005	0.016	0.019	0.037

t statistics in parentheses; *** significance at 1%, ** significance at 5%,

* significance at 10% level

Table 10(b): 5 Currencies: Exchange Rate Responses to the Fed Funds Target rate Surprise

Non-linear estimations, 5-minute returns in (0,45 min) window

Recession II: January 2008 - June 2009

Variable Name	CAD/$	CHF/$	EUR/$	GBP/$	JPY/$
Intercept	0.026*	0.027**	0.031**	0.023*	0.026
	(1.90)	(1.94)	(0.04)	(1.91)	(1.41)
FFT-Surprise	0.011*	0.007	0.010†	0.009†	-0.008*
	(1.76)	(1.05)	(1.46)	(1.45)	(-1.66)
R[t-1]	-0.181**	0.078	0.071	0.099	-0.181**
	(-2.16)	(0.90)	(0.84)	(1.16)	(-2.14)
Observations	135	135	135	135	135
R-squared	0.052	0.016	0.023	0.028	0.048

t statistics in parentheses; *** significance at 1%, ** significance at 5%,

* significance at 10% level, † significance at 15% level

Robustness Checks:

Linear regressions

Table 11: 5 Currencies: Exchange Rate Responses to the Fed Funds Target rate Surprise

News Surprise Coefficients and R-squared values

State of economy		Recession I: April 2001 - November 2001					Recession II: January 2008 - June 2009				
Window period (min)		5	10	20	30	45	5	10	20	30	45
JPY/S	β_2	**-0.246****	**-0.193*****	-0.048	-0.014	-0.012	0.087	**0.205****	**0.209*****	**0.129*****	**0.097*****
	Country	0.040	0.024	0.011	0.002	0.000	0.094	0.033	0.012	-0.002	-0.019
	Interaction	0.227	0.103	0.043	0.021	0.023	0.110	-0.117	-0.165	-0.108	**-0.113†**
	R^2	0.241	0.157	0.012	0.001	0.003	0.125	0.037	0.036	0.021	0.015
CAD/S	β_2	**-0.222****	**-0.192*****	-0.025	0.004	0.001	0.130	**0.184***	**0.182*****	**0.109****	**0.067****
	Country	0.057	**0.055****	0.003	-0.006	0.000	-0.030	-0.036	-0.035	-0.017	0.000
	Interaction	0.162	0.086	-0.077	-0.069	-0.040	-0.098	-0.013	-0.027	-0.009	0.035
	R^2	0.250	0.207	0.018	0.005	0.004	0.113	0.034	0.034	0.020	0.012
CHF/S	β_2	**-0.138†**	**-0.143****	-0.034	-0.008	-0.001	0.089	0.171	**0.161*****	**0.097****	**0.072****
	Country	-0.055	-0.028	-0.006	-0.002	-0.001	-0.010	0.000	0.012	0.006	0.004
	Interaction	-0.268	-0.154	-0.027	-0.006	-0.033	0.110	0.051	0.072	0.050	0.011
	R^2	0.259	0.165	0.010	0.001	0.003	0.113	0.031	0.031	0.019	0.011
EUR/S	β_2	**-0.148†**	**-0.145*****	-0.040	-0.014	-0.012	0.114	0.161	**0.155****	**0.095****	**0.066****
	Country	-0.062	**-0.067*****	-0.012	0.003	0.001	-0.008	0.017	0.009	0.012	0.012
	Interaction	-0.192	-0.150	0.001	0.025	0.021	-0.020	0.102	0.102	0.059	0.042
	R^2	0.256	0.225	0.013	0.001	0.002	0.112	0.033	0.032	0.019	0.012
GBP/S	β_2	**-0.213****	**-0.194*****	-0.051	-0.015	-0.013	0.127	**0.186***	**0.172*****	**0.105****	**0.069****
	Country	0.014	0.015	0.004	0.003	0.000	-0.038	-0.014	0.002	0.001	0.004
	Interaction	0.077	0.112	0.060	0.029	0.029	-0.078	-0.023	0.018	0.008	0.025
	R^2	0.207	0.155	0.012	0.002	0.003	0.114	0.032	0.030	0.018	0.011
No. of observations		35	70	140	210	315	75	150	300	450	675

*** significance at 1%, ** significance at 5%, * significance at 10% level, † significance at 15% level

Note: T-statistics and statistics associated with the constant and the lagged dependent variable are omitted for space considerations and are available upon request.

Non-linear regressions

Table 12: 5 Currencies: Exchange Rate Responses to the Fed Funds Target rate Surprise News Surprise Coefficients and R-squared values

State of economy		Recession I: April 2001 - November 2001					Recession II: January 2008 - June 2009				
Window period (min)		5	10	20	30	45	5	10	20	30	45
JPY/S	β_2	**-0.021*** **	**-0.020*** **	-0.001	0.001	0.002	0.004	**0.020***	**0.021*** **	**0.013*** **	**0.010*** **
	Country	**0.064***	**0.053*** **	0.005	-0.005	-0.009	0.105	0.062	0.031	0.012	-0.007
	Interaction	**0.023†**	**0.015***	-0.001	-0.001	0.001	-0.035	**-0.030***	**-0.036*** **	**-0.022*** **	**-0.017*** **
	R^2	0.230	0.221	0.004	0.002	0.007	0.150	0.043	0.048	0.026	0.018
CAD/S	β_2	-0.009	**-0.011*** **	0.001	0.001	**0.003†**	-0.012	0.006	0.004	0.002	0.001
	Country	**0.068†**	0.042	-0.011	-0.017	-0.012	-0.039	-0.037	-0.032	-0.019	0.000
	Interaction	0.009	-0.001	-0.011	-0.009	-0.008	0.016	0.012	0.013	0.009	0.010
	R^2	0.148	0.172	0.013	0.008	0.011	0.110	0.017	0.012	0.010	0.005
CHF/S	β_2	-0.007	**-0.010** **	-0.008	0.000	0.002	-0.013	0.005	**0.097** **	0.002	0.001
	Country	**-0.072***	**-0.046***	-0.002	0.004	0.009	-0.005	0.008	0.006	0.013	0.008
	Interaction	**-0.027***	**-0.019***	-0.006	0.002	0.001	0.027	0.019	0.050	0.013	0.007
	R^2	0.202	0.184	0.001	0.001	0.007	0.110	0.015	0.019	0.010	0.004
EUR/S	β_2	-0.008	**-0.011*** **	-0.002	-0.001	0.001	-0.010	0.005	0.002	0.002	0.001
	Country	**-0.082** **	**-0.069*** **	0.003	0.010	0.011	0.005	0.012	0.011	0.014	0.012
	Interaction	-0.018	-0.012	0.006	0.004	0.005	0.008	0.021	0.023	0.014	0.010
	R^2	0.207	0.222	0.006	0.003	0.009	0.104	0.015	0.012	0.010	0.005
GBP/S	β_2	-0.011	**-0.014*** **	-0.001	0.000	0.002	-0.011	0.007	0.004	0.003	0.009
	Country	0.004	-0.001	-0.009	0.003	-0.004	-0.033	-0.017	0.004	-0.001	0.004
	Interaction	0.003	0.007	0.002	0.004	0.001	0.013	0.004	0.013	0.007	0.001
	R^2	0.075	0.131	0.006	0.002	0.006	0.108	0.012	0.007	0.007	0.004
No. of observations		35	70	140	210	315	75	150	300	450	675

*** significance at 1%, ** significance at 5%, * significance at 10% level, † significance at 15% level

Note: T-statistics and statistics associated with the constant and the lagged dependent variable are omitted for space considerations and are available upon request.